

USE OF CCSDS TELEMETRY STANDARDS FOR LOW COST PLANETARY MISSIONS

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The Consultative Committee for Space Data Systems (CCSDS) is an international organization which has developed standards for telemetry, telecommand and ground distribution of science data. This paper will deal with the telemetry standards.

These standards have been accepted by most of the international space agencies and have been implemented in spacecraft such as Saturn, Mariner and Mars Observer. Their use is planned on future NASA and ESA science missions, as well as some ISAS missions. Ground systems supporting the standards have been established at JPL, GSFC and ESOC. Spacecraft hardware implementing the standards is being developed. The CCSDS standards are in the process of being adopted as ISO standards. Use of standards allows cost and schedule savings in design, development and operations.

The paper will provide a very brief introduction to the telemetry standards. Most of the paper will deal with specific ways in which the standards can be used to provide capabilities of interest to low cost planetary missions.

CCSDS standards are defined so as to allow a wide range of compatible options from very rigid to very flexible.

The CCSDS has defined two error-correcting codes - a convolutional code and a Reed-Solomon code, which may be used separately or together. Use of the CCSDS codes allows the use of higher bit rates for the same ground-spacecraft configuration or the use of smaller spacecraft or ground antennas, or lower power transmitters for same bit rate. In particular, the use of coding can provide the low error rates needed for compression, thus increasing the effective bit rate.

One of the basic concepts of the CCSDS telemetry is the separating of the user data structure, the Packet, from the communications data structure, the Frame or Virtual Channel Data Unit. Each Packet includes its source/destination identification. This allows for easy mixing and distribution of data from different sources and allows for changes to be made easily. It also allows variable rate data collection from a single source.

Another key characteristic of the Packet is that it can be variable length, with the length field included in each packet. This means that each source can define its packet length(s) to accommodate a meaningful amount of data. The length may vary from one packet to the next for a source. This facilitates the use of noiseless compression and accommodates the transmission of event-driven data at regular intervals without including fill data.

The Packets from a number of sources are multiplexed into the data field of a fixed-length Frame. Each Frame is identified as belonging to a Virtual Channel. Frames from independent Virtual Channels are then interleaved onto a single physical channel. Real-time and recorded data can be carried on a single physical channel. The tracking station can send the real-time data immediately, while sending the playback data at a lower, cheaper rate or at a more convenient time. Science and engineering data can be put into different Virtual Channels so that they can be sent to different destinations from the tracking station.

The CCSDS telemetry standards are especially useful for missions which record most of their science data on solid state recorders. The combination of variable rate and variable length Packets allows projects to take advantage of the variable rate record capability. Recording data with different priorities into different recorder partitions and connecting each partition to a Virtual Channel is one way for data to be down linked in a prioritized manner instead of the order generated.